

Claims

- [c1] 1. A protective composite sleeve material for a microwave reaction vessel, said sleeve material comprising a microwave-transparent wound layer fixed with a microwave transparent structural medium, said wound layer being selected from the group consisting of filaments and yarns.
- [c2] 2. A composite sleeve material according to Claim 1 wherein said structural medium is a first polymer layer on one surface of said wound layer.
- [c3] 3. A composite sleeve material according to Claim 2 further comprising a chemically-inert inner liner on the opposite surface of said wound layer from said first structural polymer.
- [c4] 4. A composite sleeve material according to Claim 3 and further comprising a chemically inert outer liner on said first structural polymer.
- [c5] 5. A composite sleeve material according to Claim 4 wherein said first structural polymer comprises a polyimide resin.
- [c6] 6. A composite sleeve material according to Claim 5 wherein said inner and outer liners are tetrafluoroethylene polymer.
- [c7] 7. A composite sleeve material according to Claim 4 and further comprising at least one additional textile layer and one additional structural polymer layer between said first structural polymer layer and said inert outer liner.
- [c8] 8. A composite sleeve material according to Claim 7 wherein said additional textile layer is selected from the group consisting of wound filaments, wound yarns, woven fabric, braided fabric, nonwoven fabric, and knitted fabric.
- [c9] 9. A protective composite sleeve for a microwave transparent vessel, said sleeve comprising:
a microwave transparent inner cylindrical polymeric layer;
a first microwave transparent wound layer adjacent to and concentric with said inner polymeric layer in which said winding is selected from the group consisting of filaments and yarns; and

a microwave transparent outer polymeric layer.

- [c10] 10. A composite sleeve according to Claim 9 and further comprising a structural polymer layer between said wound layer and said outer polymeric layer.
- [c11] 11. A composite sleeve according to Claim 10 wherein said structural polymer layer comprises an engineering resin.
- [c12] 12. A composite sleeve according to Claim 11 wherein said engineering resin is a polyimide.
- [c13] 13. A composite sleeve according to Claim 10 further comprising a plurality of pairs of adjacent concentric layers of structural polymer and textiles between said inner and outer polymeric layers.
- [c14] 14. A composite sleeve according to Claim 13 wherein said textile layers in said pairs are selected from the group consisting of woven fabrics, braided fabrics, nonwoven fabrics, and knitted fabrics.
- [c15] 15. A composite sleeve according to Claim 13 wherein said textile layers in said pairs comprise a winding selected from the group consisting of filaments and yarns.
- [c16] 16. A composite sleeve according to Claim 9 wherein said inner and outer polymer layers comprise a tetrafluoroethylene polymer.
- [c17] 17. A self sealing vessel assembly for high pressure microwave assisted chemistry, said vessel assembly comprising:
a polymeric reaction cylinder and a circular polymeric cap for said cylinder;
said cylinder being closed at one end and open at the other end to receive said cap;
said open end of said cylinder comprising a lip that is beveled inwardly from said open end,
said circular polymeric cap having a beveled lower edge that engages said beveled lip when said cap is place upon said polymeric cylinder; and
a choke cylinder depending from said beveled lower edge of said cap, said choke cylinder having an outer diameter substantially the same as the inner

diameter of said polymeric cylinder so that said choke provides a self sealing mechanism for said cylinder as pressure from a chemical reaction increases within said cylinder.

[c18] 18. A vessel assembly according to Claim 17 wherein said cap and said cylinder both comprise fluorinated hydrocarbons.

[c19] 19. A vessel assembly according to Claim 17 further comprising a composite sleeve surrounding said polymeric cylinder, said composite sleeve including at least one wound layer in which the winding is selected from the group consisting of filaments and yarns.

[c20] 20. A vessel assembly according to Claim 17 and further comprising a supporting frame that extends along said cylinder and across said lid and across said closed end of said cylinder for preventing said lid from being displaced from said cylinder when pressure is generated inside of said vessel.

[c21] 21. A vessel assembly according to Claim 20 wherein said frame comprises an adjustable tightening means that urges said lid against said cylinder.

[c22] 22. A vessel assembly according to Claim 21 wherein said tightening means comprises:
a threaded opening in said frame; and
a bolt in said threaded opening.

[c23] 23. A self sealing vessel assembly for high pressure microwave assisted chemistry, said vessel assembly comprising:
a polymeric cylinder and a circular polymeric cap for said cylinder;
said cylinder being closed at one end and open at the other end to receive said cap;
said open end of said cylinder comprising a lip that is beveled inwardly from said open end;
said circular polymeric cap having a beveled lower edge that engages said beveled lip when said cap is placed upon said polymeric cylinder;
a composite sleeve surrounding said polymeric cylinder, said composite sleeve including at least one wound layer in which the winding is selected from the

group consisting of filaments and yarns; and
a supporting frame that extends along said cylinder and across said lid and
across said closed end of said cylinder for preventing said lid from being
displaced from said cylinder when pressure is generated inside of said vessel.

[c24] 24. A vessel assembly according to Claim 23 and further comprising a choke
cylinder depending from said beveled lower edge of said cap, said choke
cylinder having an outer diameter substantially the same as the inner diameter
of said polymeric cylinder so that said choke provides a self sealing mechanism
for said cylinder as pressure from a chemical reaction increases within said
cylinder.

[c25] 25. A vessel assembly according to Claim 23 wherein said frame comprises:
a threaded opening in said frame adjacent said cap; and
a bolt in said threaded opening that bears on said cap when tightened in said
threaded opening.

[c26] 26. A vessel assembly according to Claim 23 wherein said cap and said cylinder
both comprise fluorinated hydrocarbons.

[c27] 27. A vessel assembly according to Claim 23 wherein said composite sleeve
comprises:
a microwave transparent inner cylindrical polymeric layer;
a first microwave transparent wound layer adjacent to and concentric with said
inner polymeric layer in which said winding is selected from the group
consisting of filaments and yarns;
a structural polymer layer between on said wound layer; and
a microwave transparent outer polymeric layer on said structural polymer layer.

[c28] 28. A composite sleeve according to Claim 27 comprising a plurality of pairs of
adjacent concentric layers of structural polymer and textiles between said first
wound layer and said outer polymeric layer.

[c29] 29. A composite sleeve according to Claim 28 wherein said textile layers in said
pairs are selected from the group consisting of woven fabrics, braided fabrics,
nonwoven fabrics, and knitted fabrics.

- [c30] 30. A composite sleeve according to Claim 28 wherein said textile layers in said pairs comprise a winding selected from the group consisting of filaments and yarns.
- [c31] 31. A composite sleeve according to Claim 27 wherein said inner and outer polymer layers comprise a tetrafluoroethylene polymer.
- [c32] 32. A vessel assembly according to Claim 23 wherein said supporting frame is flexible under a predetermined force exerted by pressure inside said cylinder and against said cap, so that the flexing of said frame at said pressure allows said cap to disengage from said cylinder and release the pressure inside.
- [c33] 33. A system for microwave assisted chemistry comprising:
a source of microwave radiation;
a cavity in microwave communication with said source; and
a plurality of vessels according to Claim 23 in said cavity.
- [c34] 34. A system according to Claim 33 wherein said source is selected from the group consisting of magnetrons, klystrons, solid state devices, and switching power supplies.
- [c35] 35. A system according to Claim 33 and further comprising a waveguide between said source and said cavity.